

**REMARKS**

Claims 14-16, 18 and 20 to 29 are pending in the Application. Claims 13, 17 and 19 have been canceled. Claims 14-16 and 22-28 have been amended. Claim 29 has been added and incorporates subject matter of canceled claims 13, 17 and 19. Further support for Claim 29 is found in the specification on page 6, lines 25-28.

**Objection to the Specification**

The Office Action alleges that "on page 14, line 16, it is indicated that cyclohexane is used as the olefin to be subject to dihydroxylation. The said sentence is objected to because, even though an olefin is required in the claimed process, there is no olefin present in the said example" (Office Action, page 2, lines 12-14).

Although Applicants' specification provides an example using cyclohexane, the subject matter of the claims is supported in the specification as originally filed. The specification, for example, describes olefins at page 5, line 16 to page 6, line 4, in the Examples on pages 10-17, and in the claims, as originally filed. Reconsideration is requested.

**Rejection under 35 USC 112, first paragraph**

The Office Action rejected Claims 13 to 28 under 35 USC §112, first paragraph. The rejection should be withdrawn in view of the modifications above and remarks below.

In order to make a rejection, the examiner has the initial burden to establish a reasonable basis to question the enablement provided for the claimed invention. *In re Wright*, 999 F.2d 1557, 1562, 27 USPQ2d 1610, 1513 (Fed. Cir. 1993).

The Office Action alleges that the specification enables the use of  $K_2OsO_4$  as a catalyst but does not enable the use of other catalysts. However, Applicants' invention is directed to a process for the dihydroxylation of olefins using transition metal catalysts to obtain monofunctional, bifunctional, and/or polyfunctional 1,2-diols of the formula (I)

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where

$R^1$  to  $R^4$  are each, independently of one another, hydrogen, alkyl, CN, COOH, COO-alkyl, COO-aryl, CO-alkyl, CO-aryl, O-alkyl, O-aryl, O-CO-aryl, O-CO-alkyl, OCOO-alkyl, N-alkyl<sub>2</sub>, NH-alkyl, N-aryl<sub>2</sub>, NH-aryl, NO, NO<sub>2</sub>, NOH, aryl, fluorine, chlorine, bromine, iodine, Si-alkyl<sub>3</sub>, CHO, SO<sub>3</sub>H, SO<sub>3</sub>-alkyl, SO<sub>2</sub>-alkyl, SO-alkyl, CF<sub>3</sub>, NHCO-alkyl, CONH<sub>2</sub>, CONH-alkyl, NHCOH, NHCCO-alkyl, CHCHCO<sub>2</sub>-alkyl, CHCHCO<sub>2</sub>H, PO-(aryl)<sub>2</sub>, PO(alkyl)<sub>2</sub>, PO<sub>3</sub>H<sub>2</sub>, or PU(O-alkyl)<sub>2</sub>, where alkyl is a linear, branched, or cyclic aliphatic organic group having from 1 to 18 carbon atoms and aryl is a 5-, 6-, or 7-membered aromatic ring containing from 4 to 14 carbon atoms and from 0 to 3 heteroatoms and is optionally fused, and where the alkyl or the aryl group optionally bears up to six substituents selected independently from the group consisting of hydrogen, alkyl, O-alkyl, OCO-alkyl, O-aryl, aryl, fluorine, chlorine, bromine, iodine, OH, NO<sub>2</sub>, NO, Si-alkyl<sub>3</sub>, CN, COOH, CHO, SO<sub>3</sub>H, NH<sub>2</sub>, NH-alkyl, N-alkyl<sub>2</sub>, PO-alkyl<sub>2</sub>, SO<sub>2</sub>-alkyl, SO-alkyl, CF<sub>3</sub>, NHCO-alkyl, COO-alkyl, CONH<sub>2</sub>, CO-alkyl, NHCOH, NHCCO-alkyl, CO-aryl, COO-aryl, PO-aryl<sub>2</sub>, PO<sub>3</sub>H<sub>2</sub>, PO(O-alkyl)<sub>2</sub>, and SO<sub>3</sub>-alkyl, where alkyl and aryl are as defined above.

comprising reacting an olefin of the formula (II)



where  $R^1$  to  $R^4$  are defined as for formula (I).

with an oxidant comprising molecular oxygen or a gas mixture comprising molecular oxygen in the presence of an osmium, ruthenium, or manganese compound in water or a water-containing solvent mixture at a pH of from 7.5 to 13; and adding an amine to achieve improved selectivity.

Further, the specification discloses at page 7, lines 15-25 that:

The transition metal catalysts used are generally oxides of the elements osmium, manganese and ruthenium, preferably osmium. These metals are generally used in oxidation states of  $> +4$ . However,

it is also possible to use catalyst precursors in lower oxidation states. These are converted under the reaction conditions into the catalytically active Os(VIII) and Os(VI) species or Mn(VII) or Ru(VIII) species. Examples of osmium catalysts or catalyst precursors which can be used are:  $\text{OsO}_4$ ,  $\text{K}_2\text{Os}_2(\text{OH})_4$ ,  $\text{Na}_2\text{Os}_2(\text{OH})_4$ ,  $\text{Os}_3(\text{CO})_{12}$ ,  $\text{OsCl}_3$ ,  $\text{H}_2\text{OsCl}_6$ ,  $[\text{CF}_3\text{SO}_3\text{Os}(\text{NH}_3)_5](\text{O}_3\text{SCF}_3)_2$ ,  $\text{OsO}_4$  on vinylpyridine,  $\text{Bu}_4\text{NOsO}_3$ . Examples of manganese catalysts or catalyst precursors which can be used are:  $\text{MnO}_2$ ,  $\text{KMnO}_4$ ,  $\text{Ca}(\text{MnO}_4)_2$ ,  $\text{MnCl}_3$ ,  $\text{Mn}(\text{OAc})_3$ . Examples of ruthenium catalysts or catalyst precursors which can be used are:  $\text{RuCl}_3$ ,  $\text{RuO}_4$ ,  $\text{RuO}_2$ .

Thus, one skilled in the art is sufficiently able to select a catalyst and practice Applicants' invention.

Further, the Office Action alleges that the specification enables some olefins but not other olefins having multiple moieties (Office Action, page 3, lines 1-3). Specifically, the Office Action alleges that "regarding the olefin, thousands of possible olefin are embraced as starting materials within the limitations of the claimed process. However, Applicants only show enablement for the use of  $\text{K}_2\text{OsO}_4$  as a catalyst in a small number of olefins" (Office Action, page 3, lines 19-21).

However, the specification need not contain an example if the invention is otherwise disclosed in such manner that one skilled in the art will be able to practice it without an undue amount of experimentation. *In re Borkowski*, 422 F.2d 904, 908, 164 USPQ 642, 645 (CCPA 1970).

For example, Applicants' specification discloses that:

...the catalyst is used in catalytic amounts relative to the olefin. In general, use is made of from 0.2 to 0.00001 equivalents, based on olefin, preferably from 0.1 to 0.0001 equivalents and particularly preferably from 0.1 to 0.0005 equivalents. The ratio of amine to metal is from 0.01:1 to 1 000:1, preferably from 0.1:1 to 100:1. Particular preference is given to using ratios of amine to osmium of from 1:1 to 50:1.

Thus, Applicants' specification as filed enables one skilled in the art to select the catalyst amounts relative to the olefin without any undue experimentation. Further, the specification does provide non-limiting Examples 1-30, using  $\text{K}_2\text{OsO}_4$  as a catalyst. Under the enablement requirement of 35 USC 112, first paragraph, the specification is enabling.

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Undue experimentation is not required to carry out the invention as claimed.

The Office Action alleges that "in order to make and use the invention as being claimed undue experimentation directed to multiple prepared catalysts would be needed. Moreover, undue experimentation would also be required in order to find out the specific reaction conditions wherein the said catalyst may properly work and the possible functional groups that may be present in the required olefin" (Office Action, page 4, line 20 to page 5, line 3).

The specification, however, discloses catalysts and reactions condition of Applicants' invention (see Specification, page 7, line 15 to page 8, line 2). Further, the specification discloses specific reaction conditions and possible functional groups that may be present in the required olefin (Specification, page 6, lines 6-19 and page 5, lines 16-24). Therefore, no undue experimentation is necessary to practice Applicants' invention.

The level of predictability in the art and the amount of direction provided by Applicants in the specification is enabling.

The Office Action indicates that "[t]he prior art of record consider catalyst as specific and therefore unpredictable. It is held that the catalyst behavior cannot be predicted because of the chemical nature of the process itself... Undue experimentation would be required to make and use different catalysts even to catalyze a similar process. See Ex parte Sixto, 9 USPQ2d 2081 (1988)."

The Specification of Applicants' invention discloses not only the transition metal catalysts at page 7, lines 15-25, but also various exemplary conditions under which the inventive process may be carried out (page 6, line 25-page 8, line 19). Accordingly, the Specification provides information that permits one skilled in the art to make and use the invention.

Rejections under 35 USC § 112

Claims 13-16 and 23-27 are rejected under 35 USC §112, second paragraph as indefinite. The rejection should be withdrawn in view of the modifications above and remarks below.

Claim 13 has been canceled, however, the subject matter of Claim 13 has

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been incorporated into new Claim 29. The phrase "osmium, ruthenium or manganese compound" is not indefinite. The Specification at page 7, lines 15-25 provides examples of osmium, ruthenium or manganese transition metal catalysts.

The Office Action further indicates that the phrase "cyclic aliphatic organic group having from 1 to 18 carbon atoms..." is indefinite and it is not clear how can a cyclic moiety have only 1 or 2 carbon atoms. However, Applicants' invention includes "where alkyl is a linear, branched or cyclic aliphatic organic group having from 1 to 18 carbon atoms," thus the alkyl can be linear, branched or cyclic. Reconsideration is requested.

Regarding Claim 16, Claim 16 has been amended to include "wherein the oxidant is a gas mixture comprising at least 15% by volume of oxygen. Reconsideration is requested

Regarding Claims 14 and 15, the Office Action alleges that the terms alkyl and aryl are not defined and proper definition of said term is essential to identify the limitations of the claimed invention. However, the terms alkyl and aryl are defined, for example, in the independent Claim 29 from which claims 14 and 15 depend. Claim 29 includes "where alkyl is a linear, branched, or cyclic aliphatic organic group having from 1 to 18 carbon atoms and aryl is a 5-, 6-, or 7-membered aromatic ring containing from 4 to 14 carbon atoms and from 0 to 3 heteroatoms and is optionally fused, and where the alkyl or the aryl group optionally bears up to six substituents selected independently from the group consisting of hydrogen, alkyl, O-alkyl, OCO-alkyl, O-aryl, aryl, fluorine, chlorine, bromine, iodine, OH, NO<sub>2</sub>, NO, Si-alkyl<sub>3</sub>, CN, COOH, CHO, SO<sub>3</sub>H, NH<sub>2</sub>, NH-alkyl, N-alkyl<sub>2</sub>, PO-alkyl<sub>2</sub>, SO<sub>2</sub>-alkyl, SO-alkyl, CF<sub>3</sub>, NHCO-alkyl, COO-alkyl, CONH<sub>2</sub>, CO-alkyl, NHC(O)H, NHC(O)O-alkyl, CO-aryl, COO-aryl, PO-aryl<sub>2</sub>, PO<sub>3</sub>H<sub>2</sub>, PO(O-alkyl)<sub>2</sub>, and SO<sub>3</sub>-alkyl." Reconsideration is requested.

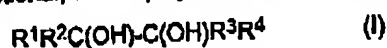
Rejections under 35 USC § 102(b)

The Office Action rejects Claims 13-18, 24 and 27 under 35 USC § 102(b) as anticipated by MacLean et al. The rejection should be withdrawn in view of the modifications above and remarks below.

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Claim 13 has been canceled, however new Claim 29 includes subject matter similar to that of canceled Claim 13. Claim 29 is related to a process for the dihydroxylation of olefins using transition metal catalysts to obtain monofunctional, bifunctional, and/or polyfunctional 1,2-diols of the formula (I)



where

$R^1$  to  $R^4$  are each, independently of one another, hydrogen, alkyl, CN, COOH, COO-alkyl, COO-aryl, CO-alkyl, CO-aryl, O-alkyl, O-aryl, O-CO-aryl, O-CO-alkyl, OCOO-alkyl, N-alkyl<sub>2</sub>, NH-alkyl, N-aryl<sub>2</sub>, NH-aryl, NO, NO<sub>2</sub>, NOH, aryl, fluorine, chlorine, bromine, iodine, Si-alkyl<sub>3</sub>, CHO, SO<sub>3</sub>H, SO<sub>3</sub>-alkyl, SO<sub>2</sub>-alkyl, SO-alkyl, CF<sub>3</sub>, NHCO-alkyl, CONH<sub>2</sub>, CONH-alkyl, NHCOH, NHCOO-alkyl, CHCHCO<sub>2</sub>-alkyl, CHCHCO<sub>2</sub>H, PO-(aryl)<sub>2</sub>, PO(alkyl)<sub>2</sub>, PO<sub>3</sub>H<sub>2</sub>, or PO(O-alkyl)<sub>2</sub>, where alkyl is a linear, branched, or cyclic aliphatic organic group having from 1 to 18 carbon atoms and aryl is a 5-, 6-, or 7-membered aromatic ring containing from 4 to 14 carbon atoms and from 0 to 3 heteroatoms and is optionally fused, and where the alkyl or the aryl group optionally bears up to six substituents selected independently from the group consisting of hydrogen, alkyl, O-alkyl, OCO-alkyl, O-aryl, aryl, fluorine, chlorine, bromine, iodine, OH, NO<sub>2</sub>, NO, Si-alkyl<sub>3</sub>, CN, COOH, CHO, SO<sub>3</sub>H, NH<sub>2</sub>, NH-alkyl, N-alkyl<sub>2</sub>, PO-alkyl<sub>2</sub>, SO<sub>2</sub>-alkyl, SO-alkyl, CF<sub>3</sub>, NHCO-alkyl, COO-alkyl, CONH<sub>2</sub>, CO-alkyl, NHCOH, NHCOO-alkyl, CO-aryl, COO-aryl, PO-aryl<sub>2</sub>, PO<sub>3</sub>H<sub>2</sub>, PO(O-alkyl)<sub>2</sub>, and SO<sub>3</sub>-alkyl, where alkyl and aryl are as defined above,

comprising reacting an olefin of the formula (II)



where  $R^1$  to  $R^4$  are defined as for formula (I),

with an oxidant comprising molecular oxygen or a gas mixture comprising molecular oxygen in the presence of an osmium, ruthenium, or manganese compound in water or a water-containing solvent mixture at a pH of from 7.5 to 13; and adding an amine

to achieve improved selectivity.

Applicants' process is directed to the catalytic dihydroxylation of olefins with molecular oxygen as an inexpensive oxidant. The amine addition to the transition metal catalyst is activated resulting in high yields and selectivities related to the diols.

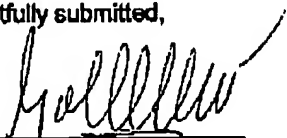
MacLean et al discloses oxidation of organic compounds using osmium tetroxide as the catalyst. Specifically, MacLean et al merely discloses two different olefins, either ethylene or octane. The method of MacLean et al discloses the oxidation of octene results to heptanoic acid and formic acid and undesired oxidation products (MacLean et al Example IV, Col. 3 to 4). MacLean et al only discloses a small amount of a diol, for example 1,2-octane diol, as further oxidized in the course of the reaction, and ethylene results in a diol yield that is extremely low, for example 2% (Examples I and II, Col. 2 and 3). The compounds obtained in the reactions of MacLean et al can be attributed to "over-oxidation (ie. CO<sub>2</sub> and formic acid). Whereas in Applicants' invention, the addition of amine simultaneous with performing the process in an aqueous medium allows a very selective conversion of the olefine to a diol with substantially improved yields, as over oxidation does not occur and may be surprisingly noted from, for example, Examples 1-30 in Applicants' specification.

Thus, MacLean et al does not disclose Applicants' invention of Claim 29. Regarding Claims 14-16, 18 and 20-28. Claims 14-16, 18 and 20-28 depend from Claim 29, either directly or indirectly, which as discussed is believed to be allowable. Reconsideration is requested.

In view of the foregoing amendments and remarks, allowance of the pending claims is earnestly requested.

Respectfully submitted,

By

  
Godfried R. Akoni  
Attorney(s) For Applicants  
Reg. No. 28,779

Bayer Chemicals  
100 Bayer Road  
Pittsburgh, Pennsylvania 15205-9741  
(412) 777-3061  
FACSIMILE PHONE NUMBER:  
(412) 777-2612

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